# REMARKS

Reconsideration of the above referenced application, as amended, is respectfully requested.

## Rejection Under 35 USC § 103

Claims 1, 2, 7, 9-12, 14 and 16-20 have been rejected under 35 USC § 103(a) as being unpatentable over U.S. Patent No. 5,157,007 to Domesle, et al. ("Domesle") in view of U.S. Patent No. 5,270,024 to Kasahara, et al. ("Kasahara") and U.S. Patent No. 4,466,947 to Imanari et al. for the reason presented in the Office Action at pages 2-5.

The Domesle reference is the primary reference which forms the basis for the rejection of all the claims. The Examiner recognizes the Domesle does not disclose the rare earth cation.

Domesle discloses the use of specific zeolites as a support for a diesel oxidation catalyst which is disclosed to treat diesel exhaust gas with control of $SO_2$ oxidation. However, Domesle requires, in addition to the zeolite, components such as platinum components for oxidation and vanadium components to inhibit $SO_2$ oxidation.

In addition to using additional catalytic elements, Domesle actually teaches away from such an assertion. Reference is made to Domesle, Examples 21 and 22. Cited Example 21 is the only Example of Domesle's 28 Examples using a zeolite (H-mordenite). However, Example 22 of Domesle is provided for comparison. The composition and the results are reproduced below from Domesle, Tables 1 and 2 at columns 11 and 12.

Domesle
Examples 21, 22

| | Noble Metal | **Carrier ($g/dm^3$)** | | |
|---|---|---|---|---|
| Ex | $g/dm^3$ | **$Al_2O_3$** | **H-Mordenite** | $V_2O_5$ |
| 21 | Pt 1.75 | 70 | 70 | 5 |
| 22 | Pt 1.75 | 140 | - | 5* |

*(from $KVO_3$)

|  |  |  | **Conversion** |  |  |  |  |
|---|---|---|---|---|---|---|---|
|  | $T_{50}$% (°C) |  | 350°C |  | $SO_2$ | (%) | NO* |
| Ex | CO | HC | CO | **HC** | 350°C | 450°C | 350°C |
| 21 | 230 | 233 | 90 | **74** | 8 | 22 | 1 |
| 22 | 232 | 236 | 89 | **74** | 10 | 24 | 2 |

*(See Table 2 at Column 12)

There is no apparent effect of using H-mordenite zeolite on hydrocarbon conversation, and Domesle does not disclose or distinguish Example 21 from Example 22 based on the effect on soot reduction. Accordingly, Domesle cannot be used to support a rejection based on inherency.

One of ordinary skill in the art is actually taught the opposite by Domesle that the zeolite is a non-catalytic support. Consistently, with Examples 21 and 22, reference is made to Domesle at column 1, lines 23 and 24, and column 2, lines 39 to 41 where the zeolite is disclosed to be an activity enhancing support, in the same class as alumina. Therefore, the use of such a zeolite by Domesle which is directed to oxidize soot particles is significant because of the absence of any suggestion that the presence of zeolite provides any catalytic contribution at all much less an effect on soot.

Therefore Domesle does not disclose or suggest the use of rare earth exchanged acidic zeolites in a method to treat diesel exhaust to reduce at least one of the size or the quantity of the soot particles.

Domesle is cited in view of Kasahara. It is asserted that it would be obvious to modify the teachings of Domesle in view of Kasahara to expect the metal cations to comprise rare earth cations. Specifically, at pages 4-5 of the Office Action, Kasahara is cited at col. 3, lines 9-25 to teach zeolite "loaded with rare-earth ions give rise to "weak acid site" in the zeolite which is capable of converting hydrocarbons contained in a lean-burning internal combustion exhaust gas…" (O.A. pages 4-5).

Kasahara is directed to a catalyst for reducing nitrogen oxides as well as HC and CO from an exhaust gas using a zeolite having a copper ion and a rare earth ion. (col. 3, lines 9-45).

Kasahara does not disclose the use of a zeolite in a diesel engine exhaust gas stream containing particles of soot and hydrocarbons wherein the hydrocarbons are cracked to reduce the size and quantity of soot particles. Kasahara discloses at column 5, lines 9-45 that "hydrocarbons having a lower reactivity, such as paraffins, can be converted to lower olefins and oxygen containing organic compounds having higher reactivity". Additionally, the rare earth ions are indicated to provide weak acid sites to suppress coke formation and thereby improved catalyst durability. This is disclosed to prevent the formation of coke on the catalyst and not to treat a soot containing diesel gas stream. There is no disclosure or suggestion that the composition of Kasahara could be used to treat diesel engine exhaust gas containing particles of soot and can reduce the size and amount of soot.

Therefore, it would not be obvious to combine Domesle with Kasahara. Domesle discloses the use of a zeolite support for catalytic components and Kasahara discloses the use of the recited zeolite, which is different than the zeolite disclosed by Domesle, for a different purpose, i.e., reducing nitrogen oxides.

Imanari is cited as teaching, "a catalyst which is applied to an exhaust gas, not only containing nitrogen oxides, but also sulfur oxides and soot." It is asserted that the catalyst is comprised of a zeolite and rare-earth metal.

Imanari teaches that soot is present in the exhaust gas (col. 1, lines 16-35). Soot is listed as a possible catalyst poison. Where zeolite is disclosed (col. 5, line 49), it is disclosed with other carriers where each being "a carrier which is inert or has very low activity". This is contrary to the presently claimed method wherein the catalyst comprises a rare earth exchanged acidic zeolite to treat diesel engine exhaust gas containing particles of soot and can reduce the size and amount of soot. There is no disclosure or suggestion in Imanari to treat soot with a rare earth exchanged acidic zeolites. At col. 5, line 39 Imanari discloses that the catalyst can contain rare earth Imanari discloses rare earth metals. However, there is no disclosure that the rare earth metals can be exchanged into an acidic zeolite. Nor is it disclosed that such an exchanged zeolite can be used in a process to reduce at least one of the size or the quantity of the soot particles.

One skilled in the art would not combine Domesle in view of Kasahara and Imanari to result in obviousness of the presently claimed invention. As indicated above, Domesle does not disclose the use of the use of rare earth exchanged acidic zeolites in a method to treat diesel exhaust to reduce at least one of the size or the quantity of the soot particles. Kasahara discloses the use of an ion exchanged rare earth on the zeolites for reducing nitrogen oxides. However, there is no disclosure or suggestion to use this material in accordance with the presently claimed process. Imanari does not lead one to use the zeolite of Kasahara in the process of Domesle. Neither Domesle or Kasahara addresses the use of rare earth exchanged acidic zeolites in a method to treat diesel exhaust to reduce at least one of the size or the quantity of the soot particles. Imanari can not be combined with Domesle and Kasahara to obviously result in the present claim. Imanari discloses an exhaust gas containing soot and a composition containing an a list of carriers which are inert or have very low activity with zeolite generally listed; and further a rare earth as a material which is separate from the carrier. Therefore, Imanari does lead one to the use of rare earth exchanged acidic zeolites in the present method.

For the above reasons, withdrawal of the rejection of claims 1, 2, 7, 9-12, 14 and 16-20 under 35 USC § 103(a) is respectfully requested.

Claims 3-6 and 8 have been rejected under 35 USC § 103(a) as being unpatentable over Domesle in view of Kasahara and Imanari and further in view of U.S. Patent No. 5,041,272 to Tamura, et al. ("Tamura") for the reason presented in the Office Action at pages 5-6.

Reference is made to the above discussion of Domesle in view of Kasahara and Imanari. Tamura is cited as disclosing that for the removal of NOx from exhaust gas of diesel engines, it is advantageous to use a zeolite of the Y type, or faujasite type or mordenite type or ZSM-5 (pentasil) which is the acidic form and which has a silica/alumina ratio of higher than 10 and 40 in the case of pentasil (column 1, lines 35-60 and column 2, lines 1-46 and column 4, lines 10-11). The advantage in Tamura is that NOx can be reduced in diesel engine exhaust without the addition of ammonia.

It is asserted that it would be obvious for one skilled in the art to use Tamura's pentasil or faujasite or mordenite in the combination with Domesle and Kasahara.

Initially, reference is made to the above discussion distinguishing Domesle in view of Kasahara and Imanari taken alone or in combination. Tamura does not compensate for the deficiency of Domesle or Domesle taken with Kasahara. Tamura discloses the use of zeolites in diesel exhaust streams in combination with one or more kinds of metals selected from the group consisting of copper, zinc, vanadium, chromium, manganese, iron, cobalt, rhodium, palladium, platinum and molybdenum. A variety of zeolites are disclosed including zeolites having silica to alumina ratios of five or more. However, there is no disclosure or suggestion of the presently claimed method or system of using a catalyst consisting essentially of a zeolite exchange with rare earth cations whereby the hydrocarbons are cracked, with partial oxidation, and at least one of the size or quantity of soot particles is reduced. For this reason the combination of Tamura with Domesle and Kasahara is not obvious to one skilled in the art.

For the above reasons, withdrawal of the rejection of claims 3-6 and 8 under 35 USC § 103(a) is respectfully requested.

Claim 15 has been rejected under 35 USC § 103(a) as being unpatentable over Domesle in view of Kasahara and Imanari further in view of U.S. Patent No. 5,000,929 to Horiuchi, et al. ("Horiuchi") for the reason presented in the Office Action at pages 6-7.

Reference is made to the above discussion of Domesle in view of Kasahara and Imanari. Horiuchi is cited as teaching that a catalyst comprising palladium and a zeolite is capable of burning carbonaceous fine particles contained in diesel engine exhaust without at the same time oxidizing $SO_2$ as long as platinum is avoided. It is asserted that it would be obvious for one skilled in the art to use the zeolite of Domesle in view of the Kasahara with palladium, because Horiuchi teaches that palladium, a species of a platinum-group metal, advantageously also does not oxidize $SO_2$, but forms part of a catalyst composition with a zeolite, which is capable of burning soot.

Horiuchi discloses the combination of a zeolite (as a support), palladium and rare earth oxides. The zeolites are disclosed as supports in a similar manner to Domesle. In Horiuchi at column 2, lines 45-50 zeolites are included in a list of refractory oxide support materials. They are used just as zeolites are included with the supports of Domesle. There is no disclosure or suggestion in Horiuchi that the zeolites participate in any way to crack hydrocarbons or reduce the size and/or quantity of soot particles. There is no specific zeolite disclosed or suggested in the Examples. More particularly, Horiuchi is distinguishable since there is no disclosure of the present claims directed to a method and apparatus relating to a catalyst consisting essentially of a zeolite having acidic properties as indicated in claim 15. As with Domesle, Examples 21 and 22, Horiuchi confirms the state of the prior art that a catalyst consisting essentially of a zeolite is not taught to be active as presently claimed. This is confirmed throughout Horiuchi. In particular, reference is made to column 3 for a method of preparing the catalyst. As indicated, the use of a zeolite is only disclosed as a support with the catalytic activity being attributed to the palladium. Reference is made to column 3, line 65 through column 4, line 15. The rare earth materials are indicated to be combined with the palladium to burn the carbonaceous fine particles at the low temperatures. There is no disclosure or suggestion that a catalyst consisting of essentially of a zeolite would crack hydrocarbons to reduce the size and quantity of diesel soot.

Horiuchi at column 4, lines 3-7 is particularly cited in the present Office Action with regard to the use of an oxide of a rare earth element to stabilize palladium. There is no disclosure that rare earth metal be exchanged in the zeolite. The rare earth as indicated in the specification of Horiuchi at column 3, line 67 to column 4, line 2 is indicated to be a separate oxide. This is supported in the Horiuchi Examples. There is no disclosure or suggestion of using a catalyst consisting essentially of a zeolite as presently claimed in the method and apparatus of the present application. Even if the zeolite can contain a rare earth metal, there is no disclosure of such a zeolitic material having cracking capability in a diesel environment. As disclosed in Domesle where a zeolite was used with a platinum material, no benefit was observed by virtue of the use of the zeolite. Therefore, Horiuchi discloses no more than Domesle.

Accordingly Horiuchi would not obviously be combined with the zeolite of Domesle to result in the method of claim 15. As discussed above, it is not obvious to combine the zeolite of Kasahara with Domesle. Therefore, one skilled in the art would not obviously combine Domesle, Kasahara and Horiuchi to obtain the method of claim 15. Horiuchi's disclosure of a composition that can burn soot but not $SO_2$ is not sufficient to make the presently claimed method obvious, since the methods are different as discussed above.

For the above reasons, withdrawal of the rejection of claim 15 under 35 USC § 103(a) is respectfully requested.

Entry of the above amendment, withdrawal of the rejection under 35 USC § 103(a) and allowance of claims 1-20 is respectfully requested.

Applicants submit their application is in condition for allowance and respectfully request the same. Should the Examiner have any further questions or require further clarification, the Examiner is invited to telephone the undersigned at the number given below.

Respectfully submitted,

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